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# Assessment of Late Complications after Laparoscopic Sleeve Gastrectomy for Morbid Obesity Patients

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## ABSTRACT

**Background:** Despite laparoscopic sleeve gastrectomy's (LSG) success as a surgical treatment for morbid obesity, complications are not uncommon and can have serious consequences, including patient death.

**Objective**: To report late complications of LSG that may be encountered after one month, including stricture, nutritional complications, and gastroesophageal reflux disease (GERD).

**Subjects and Methods:** At General Surgery Department, Zagazig University Hospitals, 18patients were involved in our prospective cohort study, they were obese with body mass index (BMI) exceeding 40kg/m$^2$ or BMI exceeding 35kg/m$^2$, and associated comorbidities such as hypertension and diabetes mellitus (DM).

**Results:** More than fourth (27.7%) of the patients were positive GERD. No mortality was reported among them, 16.7% of cases were positive gall bladder stones (GBS). Two cases (11.1%) suffered from hiatus hernia. Post-operatively, there was a considerable drop in BMI, the mean baseline BMI of cases group was 47±1.85 ranging from 44 to 50, the mean post-operative BMI after 6months became 36.78±2.67 and the mean BMI after 1year reached 31.61±2.99kg/m$^2$ and significant increase in percentage of weight loss after operation was observed. About 2/3 (64.3%) of DM cases showed full remission and 35.7% of cases were good DM controlled.

**Conclusion**: Laparoscopic sleeve gastrectomy is a simple surgical procedure resulting in low rate of late complication with insignificant long-term nutritional deficiencies, especially when compared to the other alternatives. General surgeons should have understood of the complications associated with LSG and an approach for dealing with them. Late complications include strictures, nutritional deficiencies, and GERD.

**Keywords**: Laparoscopic Sleeve Gastrectomy, Late Complications.

## INTRODUCTION

Overweight and obesity have reached epidemic proportions in the West and are beginning to impact other parts of the world. According to projections, 40% of the United States population will be clinically obese by 2025. Patients may respond best to surgery despite the availability of several nutritional treatments[(1)]. The surgical treatment of morbid obesity has advanced with the advent of laparoscopic sleeve gastrectomy (LSG). As a result, we should expect to see a sustained increase in the number of patients having this treatment. Surgeons in general should be familiar with the risks and potential solutions to LSG problems [(2)].

Significant problems are extremely rare following LSG, occurring in about 0-6% of cases. Constriction formation is a potential problem following LSG. Tissue edema following surgery can cause an immediate onset of symptoms, but more usually the condition manifests itself much later. Food intolerance, dysphagia, and vomiting and nausea are the presenting symptoms. Even though stomach kinking after LSG has been described, stenosis typically occurs at the incisura angularis. Upper endoscopy is frequently used as a diagnostic tool [(3)].

Despite the success of bariatric surgery, nutritional deficits are frequent in the post-operative period. There are a number of causes, but poor digestion and eating less are major contributors. In a study, **Gehrer *et al.*[(4)]**, deficiency of zinc, iron, folate, vitamin D as well as vitamin B12 have been described as 14%, 3%, 3%, 23%, and 3%, respectively in LSG cases.

In patients undergoing bariatric surgery, gastroesophageal reflux disease (GERD) is a common complication. Some surgeries, including the Roux-en-Y gastric bypass, are linked to a lower risk of reflux after surgery, but this is debatable for LSG. The effects of LSG on GERD have been the subject of a prior systematic review by **Chiu *et al.*** [(5)], who concluded that the data were inconclusive.

## AIM OF THE STUDY

It's to report the late complications of LSG that may be encountered after one month, including stricture, nutritional deficits, and GERD.

## SUBJECTS AND METHODS

### Subjects:

At General Surgery Department, Zagazig University Hospitals, 18 patients were involved in our prospective cohort study, they were obese patients with body mass index (BMI) exceeding 40kg/m$^2$ or BMI exceeding 35kg/m$^2$, associated comorbidities such as hypertension and diabetes mellitus (DM).

**Inclusion criteria:** Age from 15 to 60 years. Patients with a BMI of 40 or greater or a BMI of 35 or greater with at least one other obesity-related conditions such as high blood pressure, DM, high cholesterol, joint ain, or heart disease.

**Exclusion criteria:** Patients on anticoagulants or those with coagulation defects. Prior open or



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laparoscopic surgery on the esophagus, stomach, or upper intestines. People who have already had bariatric surgery. Patients with preoperative GERD and gall stones. Patients with post-operative early complications as hemorrhage, leak, and abscess. Drug abuse and psychiatric or hormonal disorders.
Follow-up of all patients post-operatively at least one year.

**A. History taking:** Full clinical history taking was obtained from each patient with special emphasis on the presenting symptoms.

**B. Clinical examination:** Both general and local examination were performed to every patient.

**C. Work-up:**

Follow-up procedures were carried out after 1 month to 12 months in outpatient clinic, for assessment of complications as well as weight loss. During the follow-up period, patients were assessed for the late complications.

Patients diagnosed with stricture by clinical symptoms include vomiting, dysphagia, and nausea or food intolerance and confirmed by UGI endoscopy treat them with endoscopy (dilatation). Patients were tested for complete blood count, serum iron , folate, vitamin B12, vitamin D and serum calcium at 1, 3, and 6 months after surgery treat them with nutritional supplements. Patients diagnosed with GERD by clinical symptoms include heartburn and regurgitation and confirmed by endoscopy treat them with proton pump inhibitor. Leak may present late diagnosis with collection intra-abdominally following LSG usually have, tachycardia, tachypnea, abdominal pain, fever as well as leukocytosis and confirmed by UGI series and abdominal US treat them with drainage and antibiotics with or without stenting. Patients diagnosed with gall bladder stone by clinical symptoms include abdominal pain, nausea, vomiting confirmed by abdominal US treat them with cholecystectomy.

**D. Laboratory and interventional investigations:**

- Complete blood picture (CBC).
- Serum iron.
- Transferrin saturation.
- Total iron binding capacity (TIBC).
- Vitamin B12: less than 74 pmol/L.
- Vitamin D: 20-40 ng/ml.
- Folate: 2.7- 17 ng/ml.
- Zink: 12 to 18 mcmol/L.
- They also underwent an abdominal ultrasound, UGI endoscopy if needed.

**Ethical consent:**

**An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.**

***Statistical analysis***

In order to analyze the data acquired, Statistical Package of Social Sciences version 20 was used to execute it on a computer (SPSS). In order to convey the findings, tables and graphs were employed. The quantitative data was presented in the form of the mean, median, standard deviation, and confidence intervals. The information was presented using qualitative statistics such as frequency and percentage. The student's t test (t) is used to assess the data while dealing with quantitative independent variables. Pearson Chi-Square and Chi-Square for Linear Trend ($X^2$) were used to assess qualitatively independent data. The significance of a P value of 0.05 or less was determined.

**RESULTS**

As shown 66.7% of cases were females and the other 33.3% were males. The mean age of cases group was 37.89±10.39 ranging from 32 to 45.5 years. The mean height was 1.68±0.06 m and the mean weight was 133.5±8.4 Kg (Table **1**).

**Table (1): Patients basic characteristics of the studied group:**

| Variables | | Study group (n=18) | |
|---|---|---|---|
| | | No. | (%) |
| **Sex** | Male | 6 | 33.3 |
| | Female | 12 | 66.7 |
| **Age (year)** | Mean ±SD range | 37.89±10.39 (32-45.5) | |
| **Height (m)** | Mean ±SD range | 1.68±0.06 (1.6-1.8) | |
| **Weight (Kg)** | Mean ±SD range | 133.5±8.4 (126.5-140.25) | |

More than 3/4 (77.8%) of cases were diabetic patients with type II and 44.4% were hypertensive (Figure **1**).

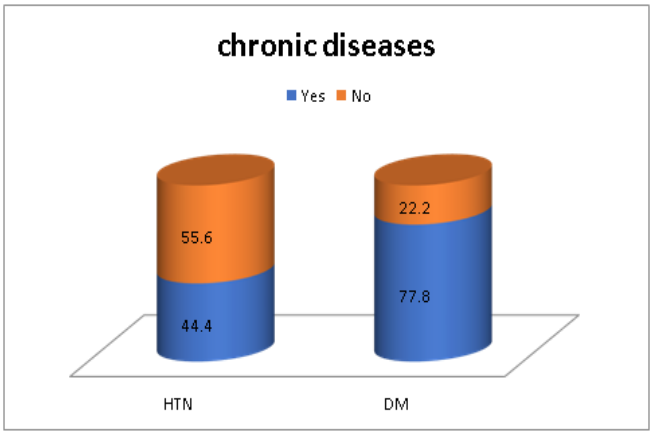


**Fig. (1): Bar chart representing co-morbidities of the studied group.**

As shown in this table, 38.9% of case had vitamin D deficiency, 16.7% of cases had low zinc, and 16.7% of cases had low folate, 27.8% had iron deficiency, and 22.2% had low vitamin B12 values (Table **2**).

**Table (2): Nutritional deficiency of the studied groups:**

| Variables | | Study group (n=18) | |
|---|---|---|---|
| | | No. | % |
| **VIT D** | Low | 7 | 38.9 |
| | Normal | 11 | 61 |
| **ZINC** | Low | 3 | 16.7 |
| | Normal | 15 | 83.3 |
| **FOLATE** | Low | 3 | 16.7 |
| | Normal | 15 | 83.3 |
| **Iron** | Low | 5 | 27.8 |
| | Normal | 13 | 72.2 |
| **VIT B12** | Low | 4 | 22.2 |
| | Normal | 14 | 77.8 |

In this study there were 27.7% positive GERD. With no incidence of mortality were reported among our results. The symptomatic cases were diagnosed using Upper GIT Endoscopy and treated with use of proton pump inhibitors. The current study reported two cases had hiatus hernia and these cases were managed by hernial repair with mesh. Our study reported (16.7%) of cases were positive GBS. Diagnosis was done by abdominal and pelvic ultrasound and managed by laparoscopic cholecystectomy. All cases didn't have delayed leaks or stricture (Table **3**).

**Table (3): Late Complications of the studied groups:**

| Variables | | Study group (n=18) | |
|---|---|---|---|
| | | No. | (%) |
| **GERD** | **Positive** | **5** | **27.7** |
| **GBS** | **Positive** | **3** | **16.7** |
| **Hiatus hernia** | **Yes** | **2** | **11.1** |
| **Delayed leaks** | **No** | **0** | **0** |
| **Stricture** | **No** | **0** | **0** |

As shown in this table, there were statistically significant differences between the studied groups as regard BMI where there was significant decrease in BMI after operation as the mean baseline BMI of cases group was 47±1.85 ranging from 44 to 50, the mean post-BMI after 6 months became 36.78±2.67 and the mean BMI after 1 year reached 31.61± 2.99 kg/$m^2$ (Table **4**).

**Table (4): Comparing BMI at baseline, 6 month and 12 months later of the studied group:**

| Variables | | Study group (n=18) | Repeated measure-ment ANOVA | P value | Between groups |
|---|---|---|---|---|---|
| **Pre-operative BMI** | Mean ±SD Range | 47.0± 1.85 (44-50) | 9.75 | **0.008*** | ---- |
| **Post-BMI 6 Months** | Mean ±SD Range | 36.78± 2.67 (35-38.25) | | | **<0.001*** |
| **Post-BMI 1 Year** | Mean ±SD Range | 31.61± 2.99 (27-38) | | | **<0.001*** |

This table shows that the percentage of weight lost varied significantly amongst the groups. Where there was significant increase in % of weight loss after operation as the mean % of weight loss after 6 months of cases group was 21.77±3.9 and the mean % of weight loss after 1 year was 32.6±4.5 (Table **5**).

**Table (5): Percentage of weight loss after 6 months and 1 year of the studied group:**

| Variables | | Study group (n=18) |
|---|---|---|
| **% of weight loss after 6 months** | Mean±SD Range | 21.77±3.9 (14-28.26) |
| **% of weight loss after 1 year** | Mean±SD Range | 32.6±4.5 (24-40.4) |
| **Paired t test** | Test | -24.135 |
| | P value | <0.001* |

As shown 64.3% of diabetic cases showed full remission, 35.7% of cases were controlled, and 62.5% of hypertensive cases showed improvement (Fig. **2**).

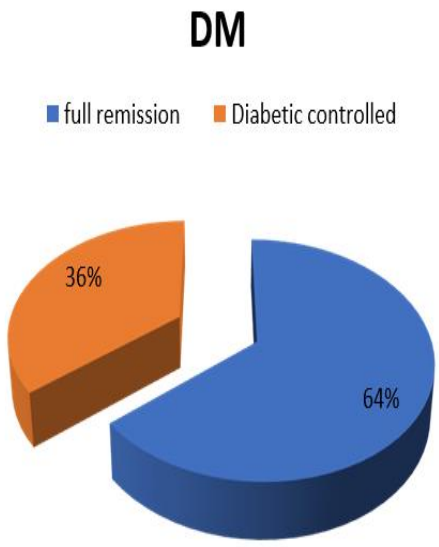


**Fig. (2): Pie chart representing resolution of DM in diabetic cases**

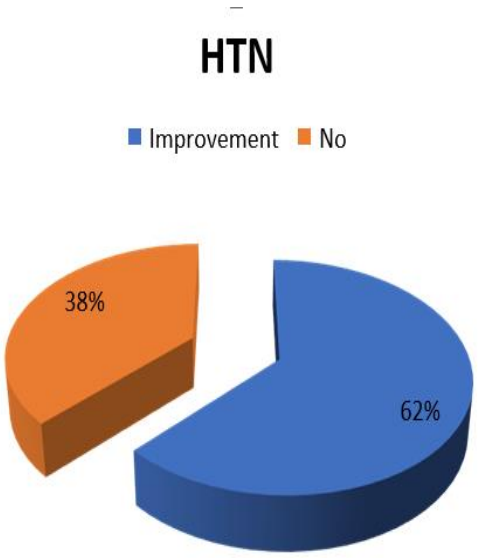


**Fig. (3): Pie chart representing resolution of DM in diabetic cases**

As shown in this table, Pre-BMI and BMI 6 months later were positively correlated statistically (r=0.740; p<0.001) and pre-BMI and post-BMI 1 year (r=0.713; p=0.001). Also, there was a statistically significant positive correlation between post-BMI 6 months and post-BMI 1 year (r=0.938; p<0.001). Both 6-month and 12-month weight loss percentages were negatively correlated with pre-operative body mass index. There was also a statistically significant inverse relationship between post-6-month BMI and both 6-month and 12-month weight-loss percentages. Post-12-month body mass index (BMI) had a statistically significant inverse relationship with both 6-month and 12-month weight loss percentages (Table **6**).

**Table (6): Correlation between age, weight, post-BMI and different parameters within the studied groups:**

| Variables | | Age | weight | post-BMI 6 months | post-BMI 1 years |
|---|---|---|---|---|---|
| **Age** | r | 1 | 0.123 | 0.198 | 0.116 |
| | p | ------ | 0.628 | 0.430 | 0.647 |
| **Weight** | r | 0.123 | 1 | 0.357 | 0.387 |
| | p | 0.628 | ----- | 0.146 | 0.113 |
| **"Pre BMI** | r | -0.074 | 0.011 | **0.740**$^{**}$ | **0.713**$^{**}$ |
| | p | 0.772 | 0.964 | **0.000** | **0.001** |
| **post-BMI 6 months** | r | 0.198 | 0.357 | 1 | **0.938**$^{**}$ |
| | p | 0.430 | 0.146 | ----- | **0.000** |
| **post-BMI 1 years** | r | 0.116 | 0.387 | **0.938**$^{**}$ | 1 |
| | p | 0.647 | 0.113 | **0.000** | ------- |
| **% Of Weight loss after 6 months** | r | -0.338 | **-0.506**$^{*}$ | **-0.850**$^{**}$ | **-0.785**$^{**}$ |
| | p | 0.170 | **0.032** | **0.000** | **0.000** |
| **% Of Weight loss after 12 months** | r | -0.220 | **-0.519**$^{*}$ | **-0.843**$^{**}$ | **-0.913**$^{**}$ |
| | p | 0.381 | **0.027** | **0.000** | **0.000** |

This table shows that Twelve-month body mass index (BMI) and percentage-of-weight-loss results showed no statistically significant differences between the ages of the study groups but there was significant relation between age and weight loss at 12 month with younger age <39 was associated with more weight loss (Table **7**).

**Table (7): Relation between age group, BMI and weight loss**

| Variables | Age group | | Tests | |
|---|---|---|---|---|
| | <39 years (n=9) | ≥ 39 years (n=9) | t | P value |
| **Pre BMI** | 47.33±1.5 | 46.67±2.18 | 0.756 | 0.462 |
| **post--BMI 6 months Mean ±SD** | 36.22±2.44 | 37.33±2.92 | -0.877 | 0.393 |
| **post-BMI 12 months** | 31.33±2.69 | 31.89±3.41 | -0.384 | 0.706 |
| **% Of Weight loss after 6 months (Mean ±SD)** | 23.48±3.95 | 20.06±3.2 | 2.019 | 0.045* |
| **% Of Weight loss after 12 months Mean ±SD** | 33.8±4.76 | 31.39±4.14 | 1.147 | 0.268 |

## DISCUSSION

A sleeve gastrectomy is a bariatric procedure that involves the longitudinal excision of the fundus, corpus, and antrum to form a tubular channel along the minor curvature of the stomach, while leaving the pylorus unremoved. About 80% of the stomach was removed, leaving a leftover gastric volume of more than 100 mL. It's a rather simple method compared to others [(6)].

Growing numbers of people e are opting for laparoscopic sleeve gastrectomy (LSG) because of its favorable weight loss outcomes, ability to address co-morbidities, and ease of surgical performance. As of 2014, LSG had surpassed gastric bypass as the most prevalent bariatric procedure, accounting for 45.9 percent of all such operations. Findings from the 2014 IFSO World Survey[(7)].

Regarding the demographic features of the patients, 18 Egyptian morbid obese patients underwent LSG treatment in our unit, comprising 12 women and 6 men with a mean age of 37.89±10.39 years ranged between 32-45.5 years. Preoperative mean baseline weight BW and height were 133.5±8.4 kg and 1.68±0.06 m, respectively. Comparable demographic findings were mentioned with the Egyptian study conducted by **Mamdouh and Naga[(8)]** who reported the mean height was 1.72 ±0.063 cm and the mean baseline weight was 126.84 ±9.93kg in their study with total studied cases were 50 patients, also they showed that the majority were female 76% compared to only 24% males with the total mean age 35.22±8.33.

Females constituted the majority of our patients 12/18 (66.7%). This gender incidence was matched with that reported by **Mohamed *et al.*[(9)]** (78.7%) also with **Sherif *et al.*[(10)]** 18/20 (80%).

In our study among the included cases about (38.9%) of case had vitamin D deficiency, (16.7%) of cases had low zinc and (16.7%) of cases had low folate, (27.8%) had iron deficiency and (22.2%) had low vitamin B12 values. **Aarts and colleagues[(11)]** Nutritional Deficiency (ND) is a severe danger for people who have had a sleeve gastrectomy (SG) because to poor food intake and absorption. Sixty patients were found to have deficiencies in several nutrients, including 43% with iron, 39% with vitamin D, 26% with anaemia, 15% with folic acid, 15% with hypoalbuminemia, and 9% with vitamin B12. After LSG, deficiency among zinc, iron, folate, vitamin D as well as vitamin B12 have been described as and 14%,3%,3%,23%, and 3%, respectively, by **Gehrer *et al.*[(4)]**.

Patients with morbid obesity often lack vital nutrients due to their bad eating habits. If pre-existing ND is not treated, micronutrient levels may drop even lower after surgery [(12)]. Absorption of some vitamins and minerals may be diminished due to the resection of the gastric fundus in Sleeve Gastrectomy LSG, Vitamin B12, folate, and iron levels drop, just like they do after a partial gastrectomy for peptic ulcer disease[(13)].

In this study there were 27.7% were positive GRED. With no incidence of mortality were reported among our results. The symptomatic cases were diagnosed using Upper Gi Endoscopy and treated with use of proton pump inhibitors, while two cases had hiatus hernia and managed by hernial repair. **Oor *et al.* [(14)]** there were a total of 24 studies included in the meta-analysis, with results showing a range of 0% to 34.9 % in cases of newly-developing GERD symptoms. There is a lot of variation in the results of these trials, but overall they support the idea that SG can cause GERD symptoms in people who didn't have them before surgery.

The current study reported two cases had hiatus hernia and these cases were managed by hernial repair with mesh, these findings corroborated the case report of a hiatal hernia 2 years after SG made by **Amor *et al.* [(15)].** Regaining weight was linked to having a hiatal hernia. Trying to pinpoint what exactly causes a pouch to herniate is a major challenge. This problem can be effectively treated by switching from a sleeve gastrostomy to a Roux-en-Y gastric bypass.

Our study reported (16.7%) of cases were positive GBS. Diagnosis was done by abdominal and

pelvic US and managed by laparoscopic cholecystectomy. Consistent with the findings of **Sioka *et al.* [16],** who found that the incidence of post-bariatric GS at 12 months was 22.7%, the current study found no significant difference between the pre- and post-bariatric GS rates.

A study conducted by **Shubayr *et al.* [17]** on 57 individuals who had undergone bariatric surgeries found an increased incidence of GB stones. Patients are almost exclusively female (87.7 percent), with only 12.3 percent being male. Patients between the ages of 18 and 30 made up just under half of the study population, while those between the ages of 30 and 40 accounted for 36.8 percent. In the study, researchers found that 61.4% of the Saudi population experienced gallstones after bariatric surgery.

This is because the concentration of biliary mucus in the gallbladder and the saturation of cholesterol in the bile both rise during rapid weight loss [17].

Comparing BMI at baseline, 6 month and 12 months later of the studied group, in terms of body mass index, there were statistically significant variations between the groups. Where there was significant decrease in BMI post-operative as the mean baseline BMI of cases group was 47±1.85 ranging from 44 to 50, the mean post-BMI after 6 months became 36.78±2.67 and the mean BMI after 1 year reached 31.61± 2.99 kg/m$^2$.

Similar to our results, the study done by **Musella *et al.*[18]**, after SG, showed BMI decreased from basal 47.9 to 32.6 after one year with total BMI loss after one year was 15.3 kg/m2 (little less than in our study) with statistical significance differences. Also, in **ElAtrash *et al.*[6]** there were consistent results with ours, as they showed BMI baseline was 51.93± 9.78 kg/m$^2$ at 6 months follow up was 37.73 ±6.92 kg/m$^2$ and 1 year follow up was 33.47± 5.69 kg/m$^2$ with non-statistical significant differences.

Percentage of weight loss after 6 months and 1 year follow up of the studied group showed that there was significant increase in % of weight loss after operation (p<0.001) as the mean % of weight loss after 6 months of cases group was 21.77±3.9 and the mean % of weight loss after 1 year was 32.6±4.5. Similar to our findings **Wang *et al.*[19]** identified the mean %TWL achieved was 16.0±3.4 at 3 months, 24.8±4.5 at 6 months, 34.4±6.1 at 1 year.

Improved fasting glucose, insulin resistance, and dyslipidemia have all been linked to weight loss. Bariatric surgery, SG, has been shown to be safe and effective in a number of surgical investigations, particularly in terms of the long-term decrease of comorbidities[6].

Regarding Diabetic patient who underwent laparoscopic sleeve gastrectomy in our study, about (64.3%) of diabetic cases showed full remission, and (35.7%) of cases were good DM controlled. These results were consistent with the **ElAtrash *et al.*[6]** who revealed remission rate of T2DM was achieved in 58.3% of patients for LSG. Comparable results to our results in **Nedelcu *et al.* [20]** T2D improved in 30 patients (58%), and this improvement was maintained in 52.5% of patients after 5 years of follow-up.

Regarding hypertensive cases who underwent LSG (62.5%) 5/out of 8 of cases showed improvement. A multi-center study done by **Sánchez-Santos *et al.*[21]** which similar to our results showed that hypertension improved in 63% of LSG patients.

In this study we revealed that Pre-BMI and BMI 6 months later were positively correlated statistically (r=0.740; p<0.001) and pre-BMI and post-BMI 1 year (r=0.713; p=0.001). Also, there was a statistically significant positive correlation between post-BMI 6 months and post-BMI 1 year (r=0.938; p<0.001).Both 6-month and 12-month weight loss percentages were negatively correlated with pre-operative body mass index. There was also a statistically significant inverse relationship between post-6-month BMI and both 6-month and 12-month weight-loss percentages.

Post-12-month body mass index (BMI) had a statistically significant inverse relationship with both 6-month and 12-month weight loss percentages. **Aslaner *et al.* [22]** revealed statistically significant differences between preoperative and post-operative mean weight loss, body mass index, percent BMIL, and percent EBMIL over the first year after surgery.

Our study showed that there was significant difference between age group below 39 and % of weight loss 6 months after surgery ($p$=0.045), showing better results in younger patients. While **Contreras *et al.* [23]** Those patients who are younger than 45 years old show more BMI loss than those who are older than 45 years old, leading to a statistically significant difference in the percent EBMIL 12 months following surgery (p <0.001).

## CONCLUSION

Laparoscopic sleeve gastrectomy is a simple and effective surgical procedure resulting in low rate of late complication with insignificant long-term nutritional deficiencies, especially when compared to the other alternative. General surgeons should have understood of the complications associated with LSG and an approach for dealing with them. Late complications include strictures, nutritional deficiencies and gastroesophageal reflux disease (GERD).

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